

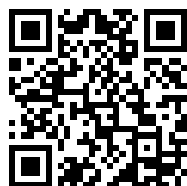
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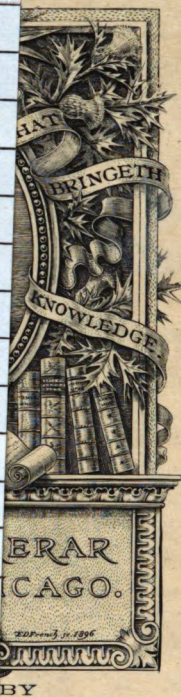


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**Raw Water Distilling Plants
for Producing Distilled
Boiler Feed Make-Up Water**
(Third Edition)



BY JOSEPH PRICE

Raw Water Distilling Plants for Producing Distilled Boiler Feed Make-Up Water

BY JOSEPH PRICE, Sc. B.

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COMPLIMENTS OF
THE GRISCOM-RUSSELL COMPANY
90 WEST STREET, NEW YORK

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Third Edition 1922

Benefits secured by the use of Pure Boiler Feed Water

[1] The benefits secured by the use of pure boiler feed water are so great and so well known that no attempt will be made here to treat the subject in detail. The objects of this paper are:

[a] To show that, with well designed evaporating, or distilling apparatus, *properly correlated* with the rest of a steam power plant, practically an absolutely pure boiler feed make-up water, and, consequently, total boiler feed, can be produced; and that the benefits accruing to the power plant as a whole, will considerably outweigh the cost of its production.

[b] To describe the several types of evaporating, or distilling plants designed and manufactured by The Griscom-Russell Co., the methods of correlating them with the rest of a steam power plant, and to aid in determining the type of plant that can be used to best advantage under given steam power plant conditions.

[2] The benefits secured by the use of purified boiler feed water reach the maximum when distilled water is used. The principal benefits are as follows:

[a] If distilled boiler feed is used, the necessity of boiler blow is practically eliminated. If raw water is used for boiler feed, it is necessary to blow from 2% to 8% of the total boiler feed, depending upon the quality of the raw water and the chemicals which may have been used for treating it. Therefore, the use of distilled boiler feed results in a saving, for this feature alone, represented by the amount of heat necessary to raise

[3]

457675

2 102 36

2% to 8% of the total boiler feed from the temperature of the raw water supply to the temperature corresponding to steam at boiler pressure.

Assuming that the water rate of a modern steam power plant is 12 lbs. per horse power per hour; that 1 lb. of coal will produce 9 lbs. of steam at a boiler pressure of 200 lbs. gauge and 388° F.; raw water at a temperature of 60° F.; and that the raw water is of such quality as to require the average 5% boiler blow; then:—

Boiler blow per horse power per hour.60 lbs.
 Heat lost per horse power per hour in
 boiler blow = .60 (361-28)200. B.T.U.
 Useful heat contained in 1 lb. of coal
 = 9 x 117110,539. B.T.U.
 Coal consumed per horse power per
 hour on account of boiler blow = $\frac{200}{10,539}$.019 lbs.

For a steam power plant of 20,000 H.P.
 and with coal costing \$4.00 per ton in
 the fire box, the saving per year due to
 eliminating boiler blow will be —

$$\frac{20,000 \times .019 \times 8,760 \times \$4.00}{2,000} \dots\dots\dots \$6,650.00$$

[b] The use of distilled boiler feed will practically eliminate the formation of scale on boiler tubes and other interior parts. As a result, for usual power plant operating conditions, the boiler tube heat transfer rate will be increased sufficiently to save from 2% to 8% of the yearly coal consumption. The approximate yearly saving for the average 20,000 H.P. steam power plant will be:

$$\frac{20,000 \times 12 \times 8,760 \times .05 \times \$4.00}{9 \times 2,000} = \$23,330.00$$

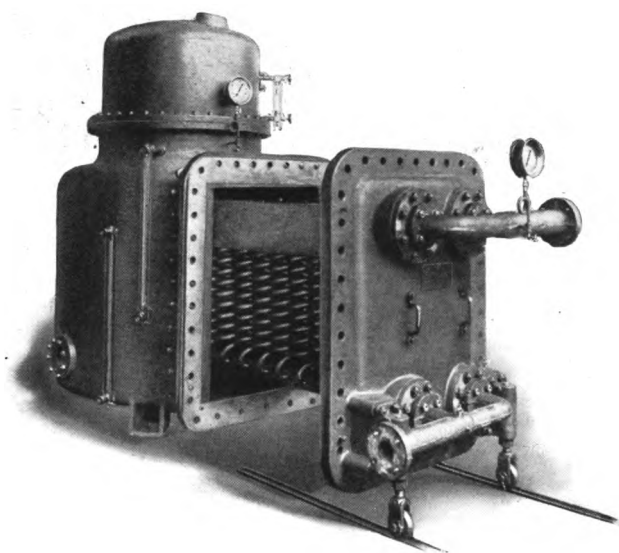
Several authorities variously estimate that $\frac{1}{16}$ " of scale on boiler heating surfaces will increase the coal consumption from 10% to 16%.

[c] Since distilled water boiler feed will practically eliminate the formation of boiler scale, the expenses otherwise due to boiler cleaning, tube replacements, idle investment, etc., will be largely eliminated. For the average 20,000 horse power steam power plant, the saving per year may be conservatively placed at \$2,000.00.

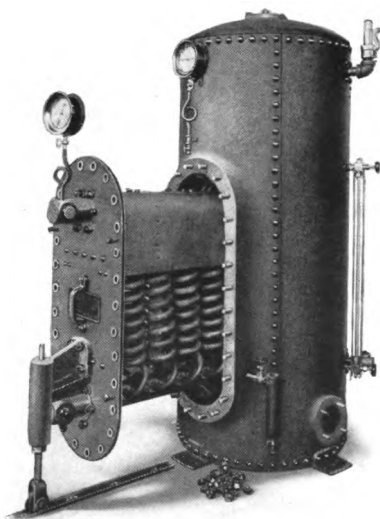
[d] The use of distilled boiler feed permits boiler operation at very large overloads without danger of priming. Cases are on record where boiler overload has been increased from 150% to 400% by the use of distilled boiler feed water instead of raw lake water of fairly good quality. The savings due to this item will be represented by the investment otherwise necessary for larger boiler equipment.

[e] In some localities, raw boiler feed of more or less unsuitable quality is now being purchased from public water works at considerable annual expense, when there is a large, free and convenient supply of impure water which, by distillation, would yield a pure boiler feed. Even sea water will yield a distilled boiler feed containing less than two grains of chlorine per U. S. gallon. [Purity required by U. S. Navy specifications covering marine evaporators.]

[f] To sum up, the use of distilled boiler feed will result in uninterrupted boiler operation at very high efficiency, and in addition will bring in very appreciable returns from the distilling plant investment. A typical detailed analysis of the yearly profits to be secured by use of a properly designed distilling plant, properly correlated with a steam power plant operating under given conditions, will be found on pages 35 to 37.



TYPICAL CAST IRON SHELL EVAPORATOR



TYPICAL STEEL SHELL EVAPORATOR

General Notes Regarding Distilling Plants and Evaporators

[3] Distilled water is commercially produced by first vaporizing the raw water in an evaporator and then condensing the vapor in a condenser (sometimes called a distilling condenser, or a distiller). If the distilled water is intended for use as boiler feed make-up, it is frequently possible, and advisable, to condense the vapor from the evaporators by passing it into the boiler feed heater, where it is condensed by means of the condensate from the main power plant condenser.

[4] Distilling plants are sometimes called evaporating plants or evaporator plants, these terms being used more or less indiscriminately.

[5] The Reilly Submerged Type Evaporator, built by The Griscom-Russell Co., consists, essentially, of a closed shell for holding the raw water, into which are introduced a number of steam coils. Live steam from the boiler, sometimes at reduced pressure, or auxiliary exhaust steam, is passed into the coils where, upon condensation, it gives up its latent heat to the raw water, thus vaporizing the raw water.

[6] Figures 1 and 2 illustrate the Reilly Submerged Type Evaporator, so called because the working water level in the evaporator shell may be carried high enough to submerge completely the heating coils, thus resulting in advantages which, on account of lack of space, may not be taken up here.

[7] Figure 3 illustrates The Griscom-Russell Type K

[7]

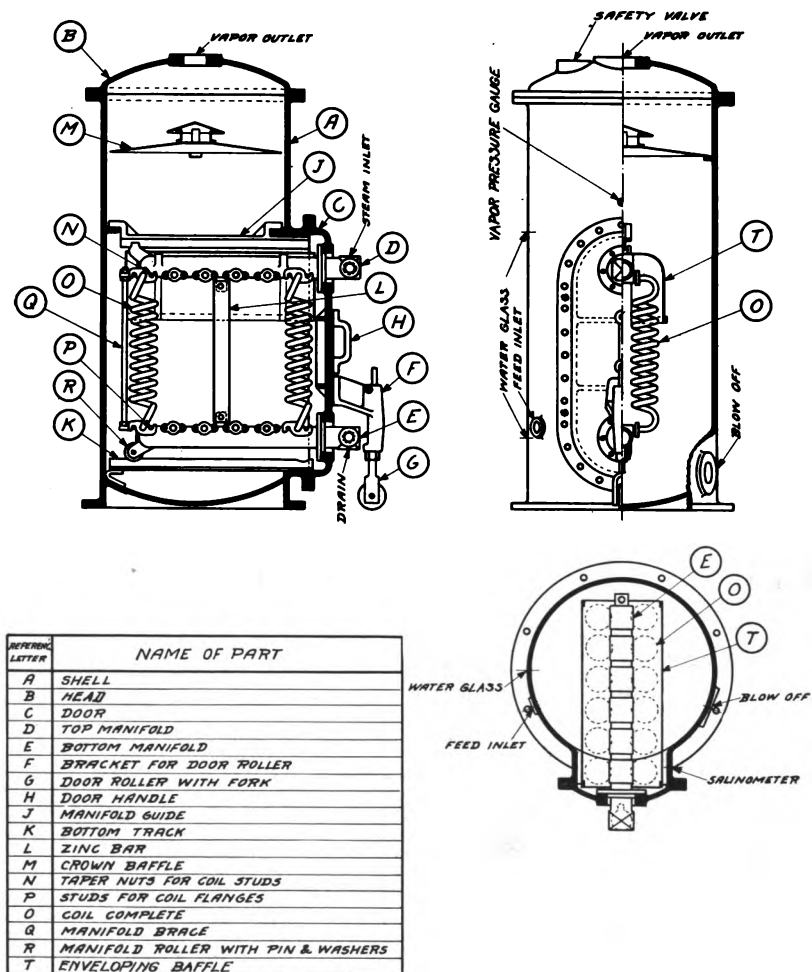


FIGURE 1
REILLY EVAPORATOR, CAST IRON SHELL

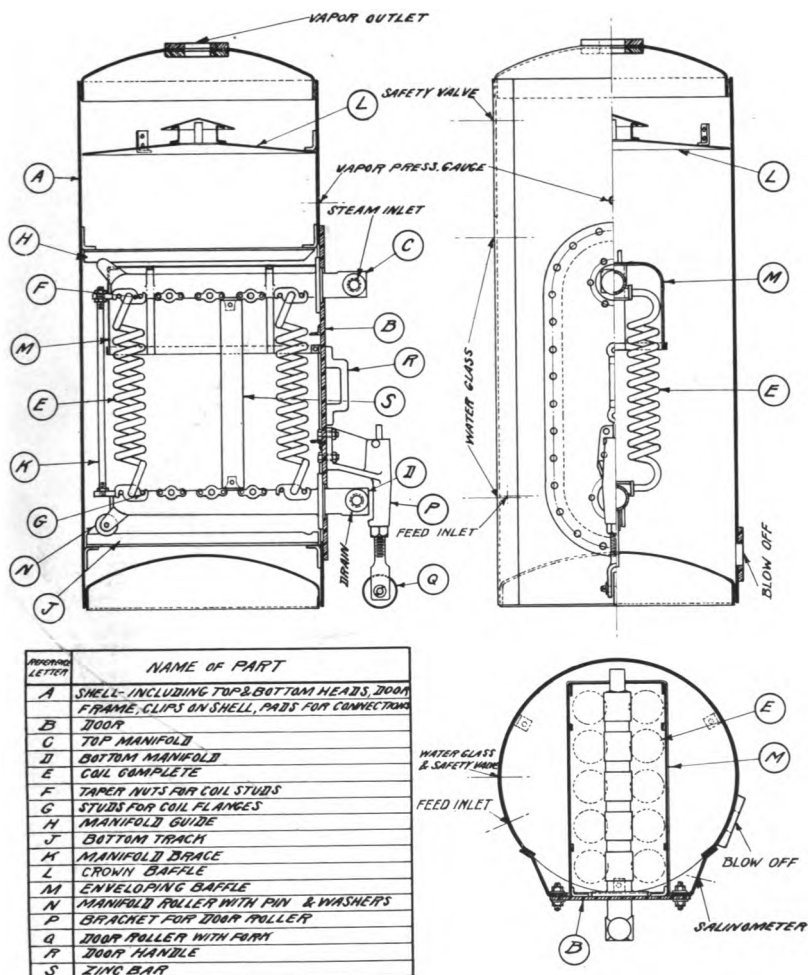


FIGURE 2
REILLY EVAPORATOR, STEEL SHELL

Distiller, and Figure 4 illustrates The Griscom-Russell Condenser for vapor pressures above atmosphere.

[8] If an evaporator is operated continuously without blowing out some water from the evaporator shell, the water in the evaporator will sooner or later become highly charged with impurities, due to an accumulation of the impurities originally contained in the raw water being evaporated. This highly concentrated liquor is undesirable and it therefore becomes necessary to blow off a certain amount from time to time, the amount depending upon the quality of the raw water being evaporated.

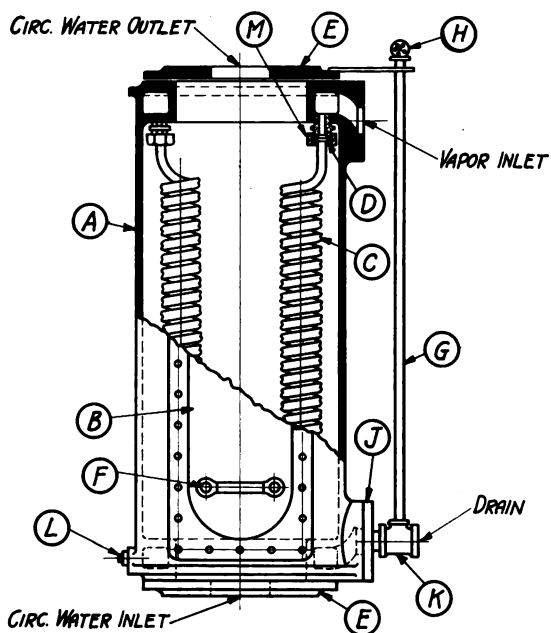
[9] For fresh water evaporator feed of fair quality, it will be advisable to blow off an amount equal to about 4% of the evaporator feed. For sea water feed at $\frac{1}{3}\frac{1}{2}$ density, it will be advisable to blow off about 35% of the feed.

[10] Insufficient blow will result in increased tendency of evaporator coils to scale up; will shorten the life of interior parts of the evaporator; will cause the evaporator to prime, or boil over, thus decreasing the purity of the distilled water produced; and will reduce the capacity of the evaporator.

[11] Well designed stationary distilling plants are fitted with automatic devices for maintaining constant predetermined rates of evaporator feed and blow.

[12] A double effect distilling plant is one in which the vapor from one evaporator, called the first effect evaporator, is condensed in the heating coils of another evaporator, called the second effect evaporator, the vapor from the second effect evaporator being condensed in the usual way in a condenser or distiller, or in the boiler feed heater.

[13] The average single effect distilling plant will produce about 1 lb. of distilled water for 1.2 lbs. of steam supplied to the evaporator coils. The average double effect distilling plant will produce about 1 lb. of distilled water for .7 lbs. of steam supplied to the first effect evaporator coils.

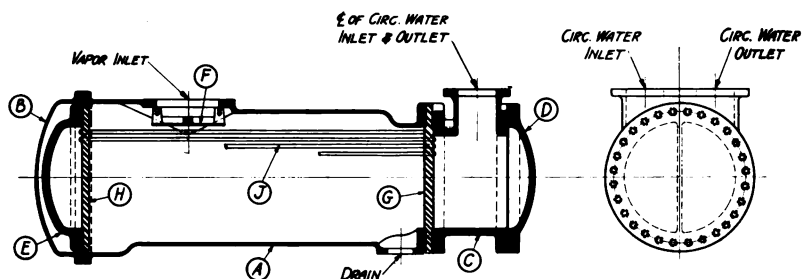


THE GRISCOM-RUSSELL TYPE "K" DISTILLER

REF. LETTER	NAME OF PART
A	SHELL
B	DOOR
C	COIL
D	COIL SPUD
E	CIRC. WATER FLANGE
F	DOOR HANDLE
G	VENT PIPE
H	VENT ROSE
J	COMP. FLANGE
K	TEE
L	PIPE PLUG FOR DRAIN
M	UNION NUT

FIGURE 3

THE GRISCOM-RUSSELL CONDENSER FOR VAPOR PRESSURES ABOVE ATMOSPHERE



REF. LETTER	NAME OF PART
A	SHELL
B	SHELL COVER
C	WATER HEAD
D	WATER HEAD COVER
E	FLOATING HEAD
F	BAFFLE PLATE
G	WATER HEAD TUBE PLATE
H	FLOATING HEAD TUBE PLATE
J	TUBES $\frac{1}{2}$ O.D. $\frac{1}{8}$ B.W.G.

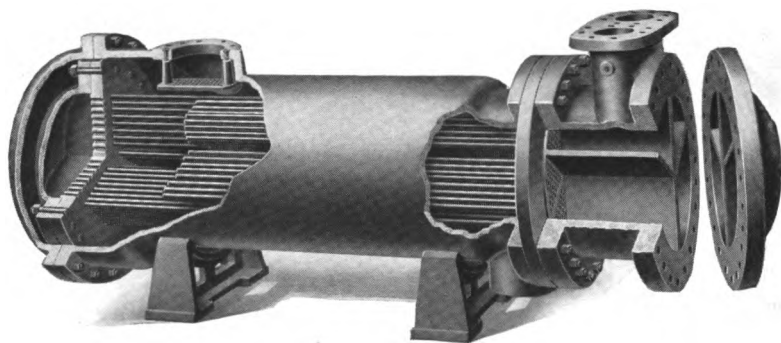


FIGURE 4

[14] Multiple effect distilling plants up to 6 effects are sometimes used, the evaporative efficiency of the distilling plant increasing with the number of effects. By evaporative efficiency is meant the ratio of pounds of distillate produced per pound of steam expended, the efficiency applying to the distilling plant alone. It will be shown later that the overall efficiency of a steam power plant equipped with a distilling plant for providing boiler feed make-up water, is independent of the number of effects in the distilling plant, provided the type of distilling plant used is properly selected and properly correlated with the steam power plant.

[15] Series feed, multiple effect evaporating plants are so piped that the feed water for the last effect evaporator is taken from an overflow from the next preceding effect, and so on, the first effect evaporator alone receiving its feed directly from the evaporator feed pump.

[16] Parallel feed, multiple effect evaporating plants are so piped that all effects take their feed directly from the evaporator feed pump, independently of each other.

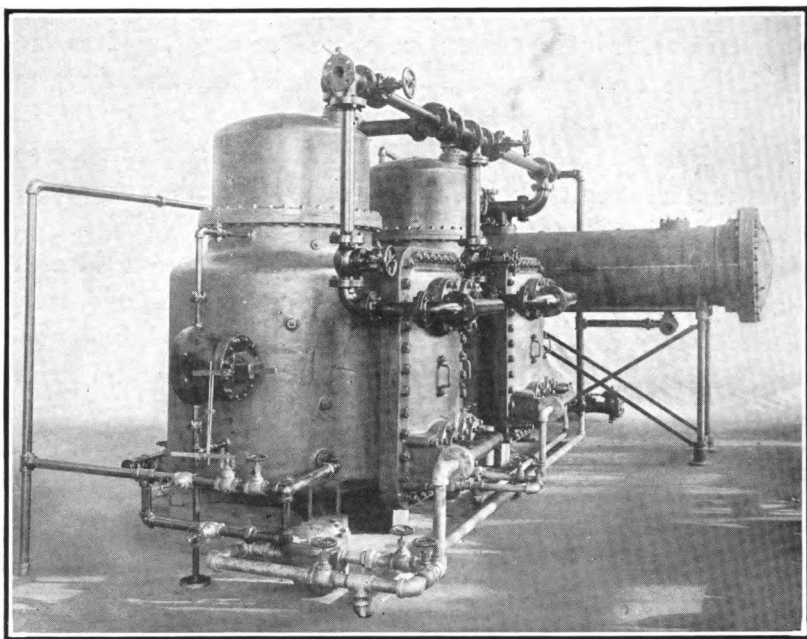
[17] In order that heat may pass from the steam through the evaporator coil walls and into the raw water, it is, of course, necessary that the steam temperature, and corresponding pressure, be maintained greater than the vapor temperature and corresponding pressure. Within working limits the heat transferred will increase directly with the temperature difference, so that, the greater the temperature difference, the less heating surface which will be required to produce a given amount of vapor.

[18] It will therefore be seen that a multiple effect evaporating plant will produce no more distilled water than a single effect evaporator of the same size as one of the multiple effect units, provided initial steam pressure and final vapor pressure are the same in both cases.

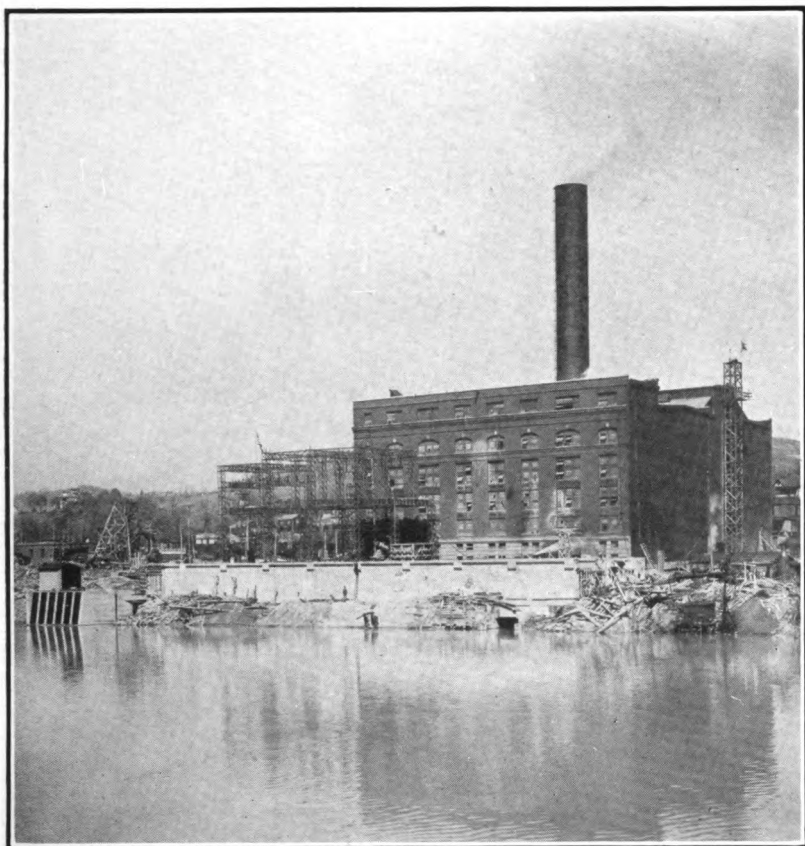
[19] From the consideration of first cost, it is therefore,

advantageous to keep the number of effects as low as possible. However, the operating conditions usually found in steam power plants will not permit the use of a single effect evaporating plant for providing distilled boiler feed make-up, if the evaporating plant is to be properly correlated with the power plant so as to result in maximum economy.

[20] It should be noted that for a multiple effect evaporating plant, all of the distilled water produced, except that part resulting from the vapor from the last effect, is condensed in evaporator coils. The amount of last effect vapor is the factor which determines the number of effects to be employed.



**HIGH HEAT LEVEL EVAPORATOR PLANT
SIMPLE TWO EFFECT**



Sanderson & Porter, Consulting Engineers

**MONONGAHELA POWER & RAILWAY CO.
FAIRMONT, W. VA.**

**Evaporator equipment for 20,000 lbs. net per hour of
distilled boiler feed make-up. Apparatus designed and
manufactured by**

THE GRISCOM-RUSSELL COMPANY



HORIZONTAL STEEL SHELL EVAPORATOR

Low Heat Level Evaporating Plants

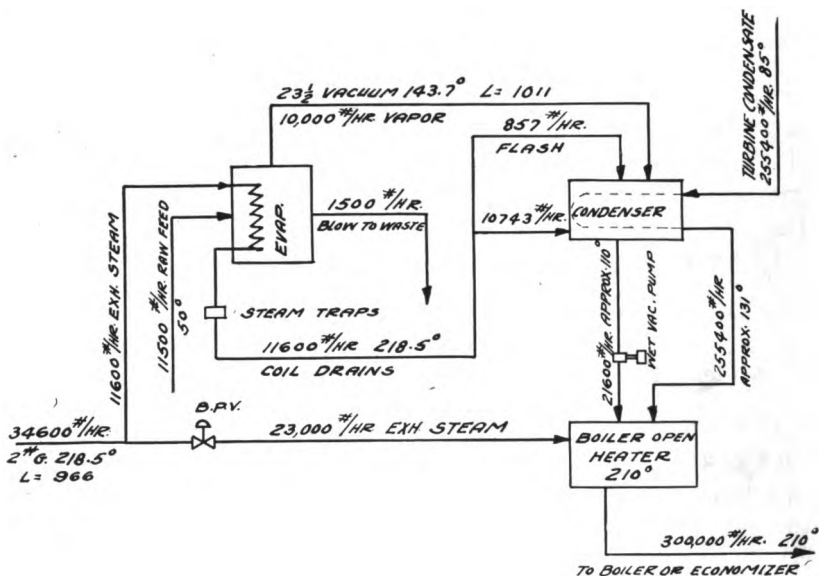
[21] If evaporation takes place at low temperatures and corresponding pressures, the distilling plant is called a Low Heat Level Plant, as distinguished from a High Heat Level Plant, the advantages of which will be presented later.

[22] The evaporators of a low heat level distilling plant may be operated with boiler steam at full or reduced pressure, or with auxiliary exhaust steam at a pressure as low as 2 lbs. gauge. If operated with low pressure exhaust steam, the vapor produced will have to be maintained at a vacuum. If operated with boiler steam, the plant is usually designed so that evaporation takes place at about 5 lbs. gauge pressure in the last effect evaporator.

[23] Evaporating plants designed to operate on auxiliary exhaust steam are generally larger, more expensive, and more complicated than evaporating plants designed to operate on high pressure boiler steam, principally because of the large specific volume of the vapor handled and the piping complications incident to evaporation under vacuum. Vacuum pumps must be used, air vents from evaporator coils must generally be led to the condenser, and evaporator blow must be handled by pumps or vacuum traps.

[24] An evaporating plant operating on exhaust steam may advisably be used for providing distilled boiler feed make-up, when the power plant operating conditions are such as to result in considerable auxiliary exhaust steam, and when it is

**APPROXIMATE HEAT DIAGRAM
FOR EVAPORATING PLANT FOR PROVIDING BOILER FEED MAKE-UP
(EVAPORATORS OPERATED WITH AUXILIARY EXHAUST STEAM)**



PLANT CONDITIONS

ONE 20,000 K.W. UNIT

EXHAUST STEAM AVAILABLE, 34,600 #/HR. AT 2" G.

TURBINE CONDENSATE, 255,400 #/HR AT 85°

TOTAL BOILER EVAPORATION, 300,000 #/HR.

MAKE-UP REQUIRED 10,000 #/HR.

RAW FEED TEMPERATURE 50° F.

ASSUME FRESH WATER FEED WITH 13% EVAPORATOR BLOW

FIGURE 5

desired to secure a low temperature of boiler feed entering an economizer. If an economizer is not used the power plant can usually be better served by a high heat level evaporating plant. Fig. 5 shows a typical diagrammatic heat balance for a single effect low heat level evaporating system, operating on auxiliary exhaust steam.

[25] A common and uneconomical method of connecting a low heat level distilling plant, operating on boiler steam, to the steam power plant is to pass the vapor from the last effect evaporator to the main power plant condenser, where it is condensed and passes out of the condenser with other condensate to the boiler feed heater, or to the hot well. The evaporator coil drains are also carried to the boiler feed heater or to the hot well. Fig. 6 illustrates a typical marine distilling plant installation of this kind.

[26] Such a system is not economical because all the latent heat and part of the sensible heat contained in the vapor from the evaporator is absorbed by the condenser circulating water and thrown away. Consequently, nearly all of the heat given up by the steam in the evaporator coils is thrown away. If the distilling plant is of the single effect type, operating on boiler steam, and if the power plant requires 5% boiler feed make-up water, all of which will be in the form of vapor from the evaporator, then approximately 5% of the total steam output of the boiler will be used up in the evaporator coils and consequently about 5% of the yearly coal bill must be charged to distillation. For some power plant operating conditions such losses would prohibit the use of distilled boiler feed make-up water.

[27] To partially eliminate these losses, multiple effect evaporating plants are resorted to at greater first cost, the advantage being that all the distilled water produced, except that part represented by the vapor from the last effect, is condensed in evaporator coils, thus doing useful work. But the

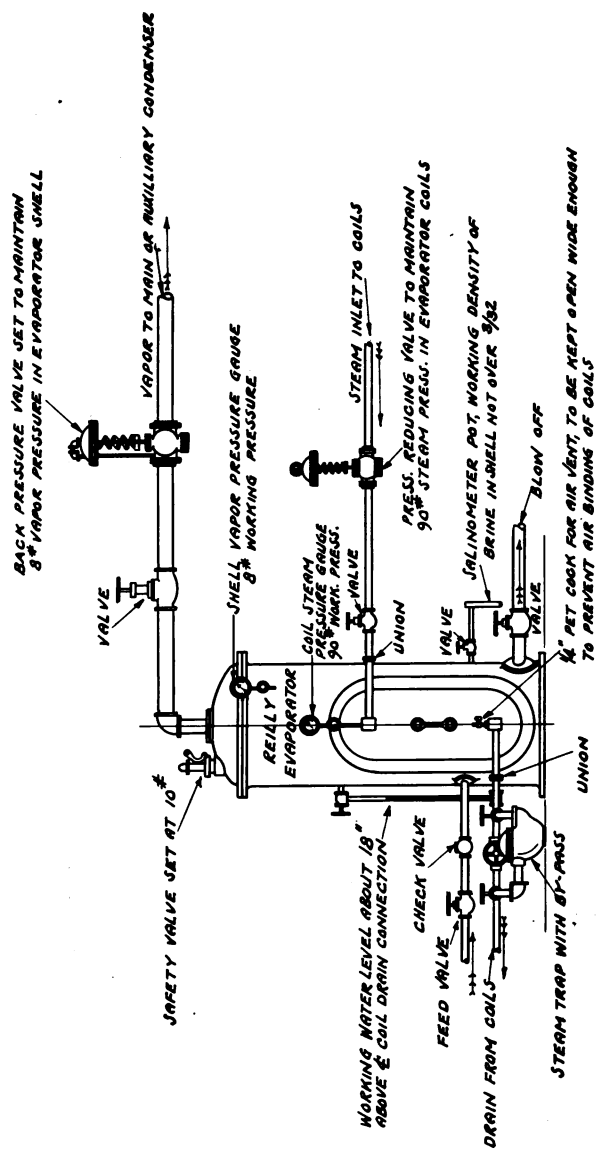


FIGURE 6

use of multiple effect plants can only partially eliminate the losses. To totally, or almost totally, eliminate such losses the method of connecting the evaporating plant to the rest of the power plant must be changed.

[28] A low heat level evaporating plant operating on boiler steam can be economically used under the following conditions:

[29] If a large part of the power plant auxiliaries are electrically driven, and there is consequently but little auxiliary exhaust steam available for use in the boiler feed heater, and if the amount of make-up water required is not over approximately 10%; the vapor from a single effect evaporator can be piped directly to the boiler feed heater where it will be absorbed by the condensate from the main power plant condenser, the resulting mixture being the correct amount of pure boiler feed at approximately 210° F.

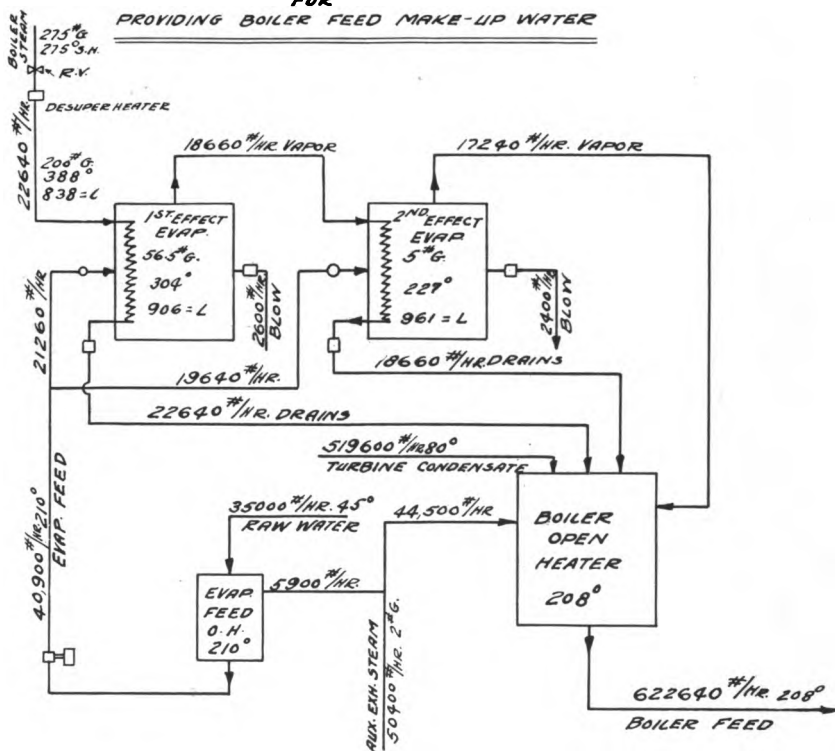
[30] If the required amount of make-up water is less than 5%, an appreciable portion of the power plant auxiliaries may generally be steam driven, and a single effect evaporating plant used as described above.

[31] If either the amount of make-up water required or the amount of auxiliary exhaust steam to be handled are so great that the necessary amount of vapor from a single effect evaporator could not be absorbed in the boiler feed heater, a multiple effect low heat level evaporating plant may frequently be used.

The usual boiler feed open heater operates at or near atmospheric pressure, so that the amount of steam which can be absorbed by the boiler feed, cannot exceed the amount necessary to raise the feed to approximately 212° F.

[32] Under the conditions above described practically all of the heat given up in the evaporator coils is finally re-absorbed in the boiler feed water, the only charges against the

**APPROXIMATE HEAT DIAGRAM
LOW HEAT LEVEL EVAPORATING PLANT
FOR
PROVIDING BOILER FEED MAKE-UP WATER**



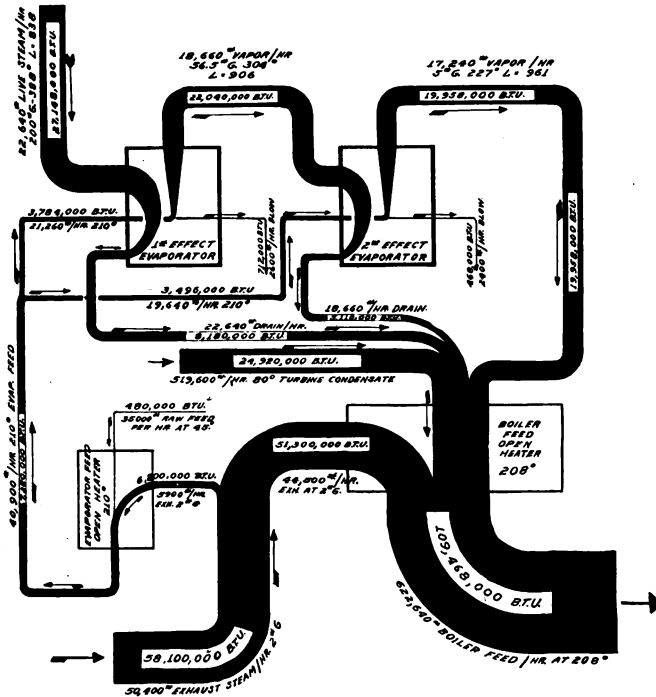
PLANT CONDITIONS

{	NET HOURLY BOILER EVAPORATION.....600,000 #
	NET HOURLY MAKE-UP.....30,000 #
	STEAM AVAILABLE.....275° G. 275° S.N.
	RAW WATER TEMP.....45°
	HOT WELL TEMP.....80°
	AUX. EXHAUST STEAM.....50400 #/HR. AT 2° G.

FOR GRAPHICAL FLOW DIAGRAM SEE FIGURE 8

FIGURE 7

**GRAPHICAL FLOW HEAT DIAGRAM
LOW HEAT LEVEL EVAPORATING PLANT
FOR
PROVIDING BOILER FEED MAKE UP WATER**



POWER PLANT CONDITIONS

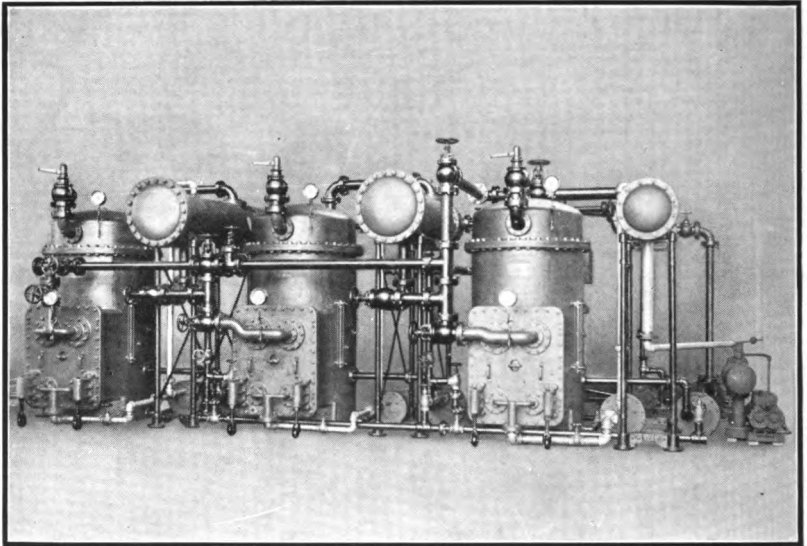
NET HOURLY BOILER EVAPORATION.....	608,000°
NET HOURLY MAKE-UP.....	3,800°
STEAM AVAILABLE.....	870° & 870° G.H.
RAW WATER TEMP.....	85° F.
HOT WELL TEMP.....	80° F.
AUX EXHAUST STEAM.....	80,400 / HR AT 8° G.

FIGURE 8

evaporator system being small heat losses due to radiation and to evaporator blow.

[33] The use of a multiple effect low heat level evaporating plant operating on boiler steam as above indicated, will, as a rule, allow the use of steam drive for the major portion of the auxiliaries, the amount of auxiliary exhaust steam together with the vapor from the last effect evaporator being not in excess of the amount of steam which can be absorbed in the boiler feed heater.

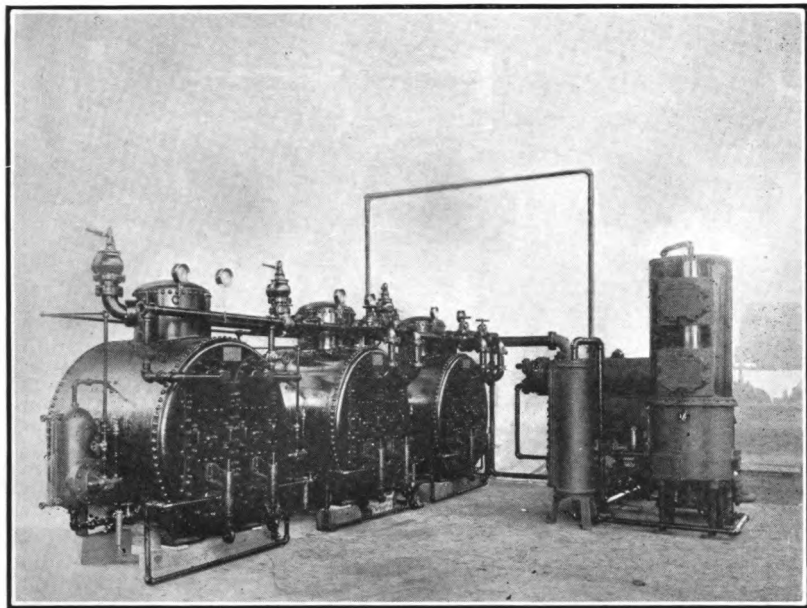
[34] Fig. 7 shows a typical diagrammatic heat balance for a two-effect low heat level parallel feed evaporating system, operating on boiler steam at reduced pressure.



**INTERNATIONAL PETROLEUM COMPANY
TALARA, PERU**

Three effect evaporator equipment with heat exchangers
for 7,000 lbs. net per hour of distilled water. Apparatus
designed and manufactured by

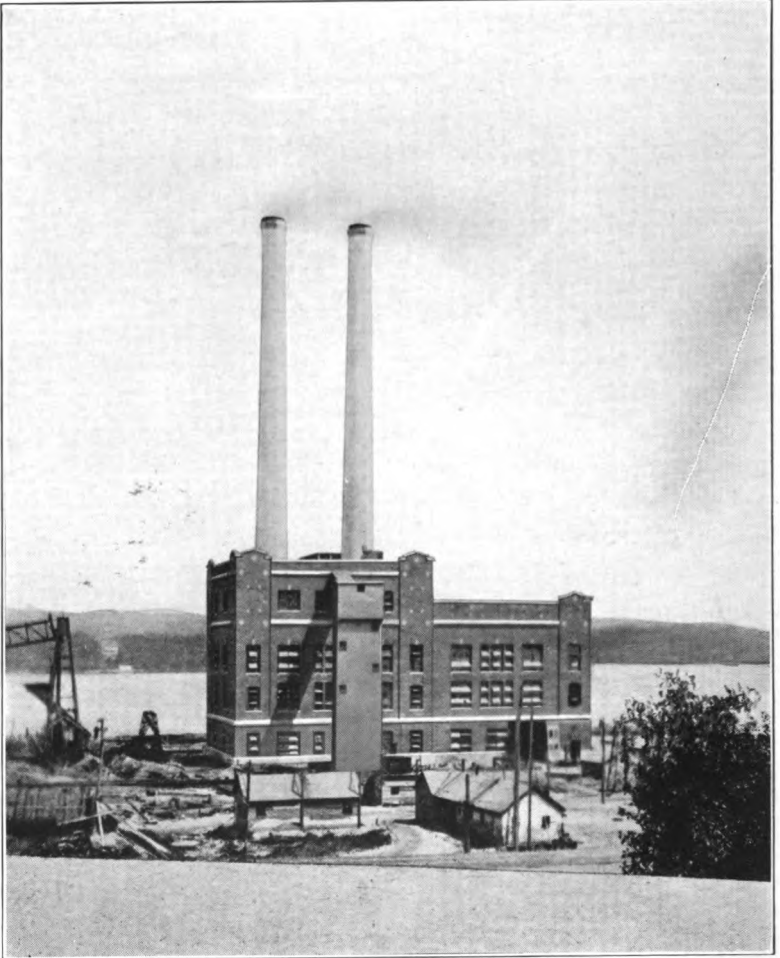
THE GRISCOM-RUSSELL COMPANY



**STANDARD OIL COMPANY
TAMPICO, MEXICO**

**Three effect evaporator equipment without heat ex-
changers for 5,250 lbs. net per hour of distilled water.
Apparatus designed and manufactured by**

THE GRISCOM-RUSSELL COMPANY



Harry M. Hope Engineering Co., Consulting Engineers.

**EASTERN CONNECTICUT POWER CO.
MONTVILLE, CONN.**

Evaporator equipment for 15,000 lbs. net per hour of
distilled boiler feed make-up. Apparatus designed and
manufactured by

THE GRISCOM-RUSSELL COMPANY

The Griscom-Russell High Heat Level Evaporating Plant for Providing Distilled Boiler Feed Make-Up Water

[35] The preceding pages have shown that in general a low heat level evaporating system operating on boiler steam can be used economically only when the power plant operating conditions are such as to result in a restricted amount of auxiliary exhaust steam, or when the amount of boiler feed make-up required is small.

[36] If there is considerable auxiliary exhaust steam, a low heat level evaporating plant operating on low pressure exhaust steam could be used, but as heretofore pointed out such an evaporating plant is comparatively large and expensive, and its operation involves the use of vacuum pumps and other complications incident to the use of any vacuum apparatus.

[37] To overcome these difficulties The Griscom-Russell High Heat Level Evaporating System has been developed.

[38] The high heat level plant differs from the low heat level plant in that evaporation takes place at comparatively high temperatures and pressures. As the vapor passing from the evaporators is at high temperatures, it can be condensed in a condenser using circulating water at a correspondingly high temperature. The Griscom-Russell High Heat Level Evaporating Plant is designed for any given power plant conditions,

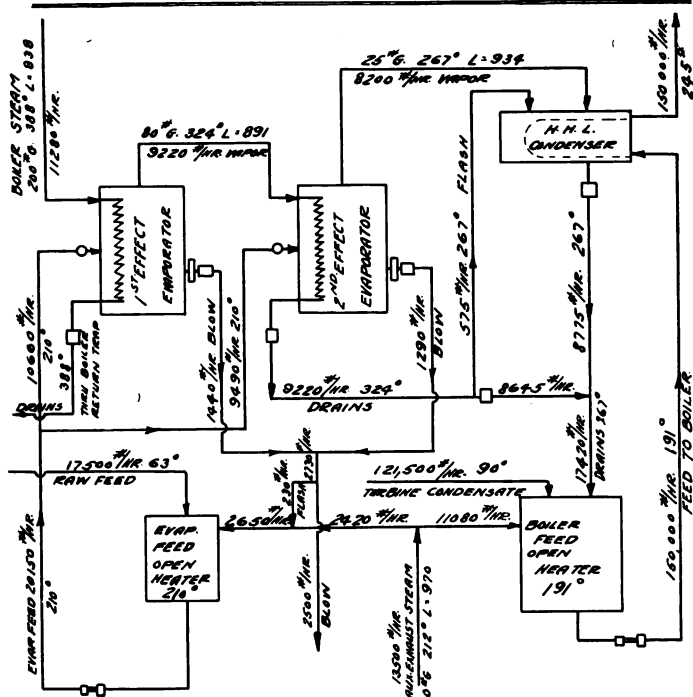
so that the vapor from the evaporators is at such temperature that it will be condensed in a special High Heat Level Condenser or combination of condensers, using boiler feed at approximately 210° F. for circulating water. The boiler feed is pumped from the boiler feed heater through the high heat level condenser, or condensers, on its way to the boiler. Drains from the high heat level condensers and from evaporator coils are passed to the boiler feed heater. High heat level evaporating plants are generally operated on full boiler steam pressure.

[39] With this system, the boiler feed water reabsorbs all the heat given up in the evaporator coils, with the exception of the small amount of heat lost through radiation and evaporator blow.

[40] Fig. 9 shows a typical diagrammatic heat balance for a two-effect, high heat level, parallel feed evaporating plant. On pages 35 to 37 will be found a detailed analysis of the yearly profits accruing to the power plant through the use of such equipment.

[41] Fig. 10 shows a sectional view of a simple two-effect parallel feed, high heat level evaporating plant, with interconnecting piping and automatic devices for maintaining constant rates of evaporator feed and blow.

APPROXIMATE HEAT DIAGRAM
HIGH HEAT LEVEL EVAPORATING PLANT
FOR
PROVIDING BOILER FEED MAKE-UP WATER



POWER PLANT CONDITIONS

BOILER STEAM 200° G. SATURATED
 EVAPORATION 150,000 #/HR
 FEED MAKE-UP 13000 #/HR
 RAW WATER ... 63° BRACKISH (ASSUME 15% EVAP. BLOWN)
 HOT WELL TEMP. 90°
 AUX. EXHAUST STEAM 13500 #/HR 0° G.

FIGURE 9



TYPICAL GRISCOM-RUSSELL CONDENSER FOR USE WITH EVAPORATORS

EXHA

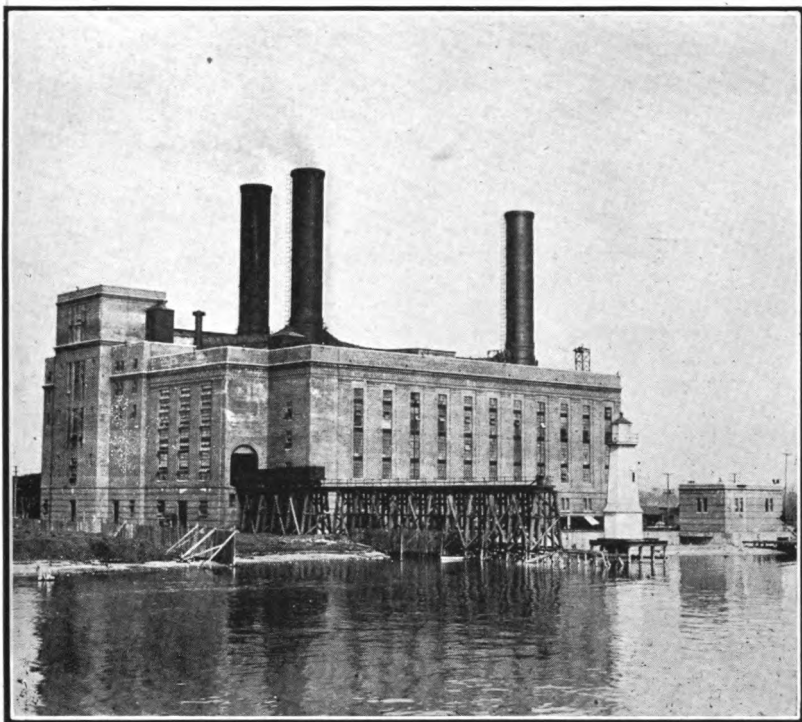
OIL

DRIP FI
WATER

FLOOR
AUTOM

FILTE

REAR
VARY

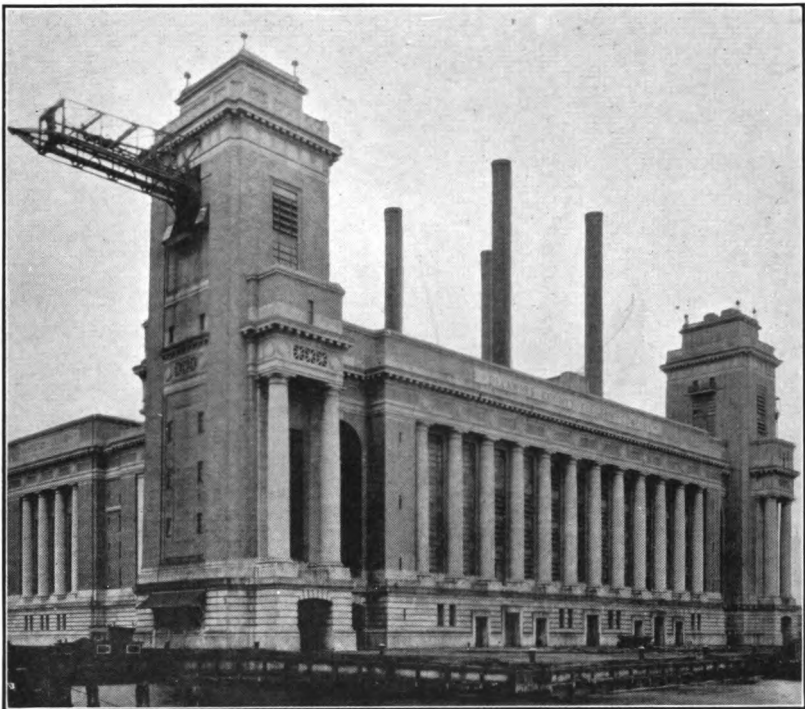


Stone & Webster, Consulting Engineers.

**BUFFALO GENERAL ELECTRIC CO.
BUFFALO, N. Y.**

Evaporator equipment for 60,000 lbs. net per hour of
distilled boiler feed make-up. Apparatus designed and
manufactured by

THE GRISCOM-RUSSELL COMPANY



PHILADELPHIA ELECTRIC COMPANY
DELAWARE COUNTY STATION
CHESTER, PA.

Evaporator Equipment for 25,000 lbs. net per hour of
distilled boiler feed make-up. Apparatus designed and
manufactured by

THE GRISCOM-RUSSELL COMPANY

Heat Benefit Analysis

APPROXIMATE HEAT BALANCE SHOWN BY FIG. 9

The following analysis of probable savings in plant operation by use of the Evaporator System is based on the following assumptions:

Net hourly boiler evaporation 150,000 lbs.
 " " " feed make-up 15,000 lbs.
 " " " blow (without evaporator system) 7,500 lbs.
 Boiler steam at 200 lbs. gauge, saturated.
 Hot well temperature 90° F.
 Raw water which would be used for
 evaporator feed 63° F. (Brackish)
 Auxiliary exhaust steam, 13,500 lbs. per hr. at
 0 lbs. g.
 Boiler evaporation, 9 lbs. of steam to 200 lbs. g.
 per lb. of coal (Useful heat per lb. of coal =
 10,513 B. T.U.)
 Cost of coal \$4.00 per 2,000 lbs.
 Cost of present make-up water
 \$1.00 per 1,000 cu. ft.
 (Purchased from Public Water Works) . . . (63°)

BOILER BLOW—

Will be practically eliminated.

Saving per year
$$\frac{7,500 \times 330 \times 8,760 \times \$4.00}{10,513 \times 2,000} = \$4,124.00$$

BOILER TUBE HEAT TRANSFER—

Will be increased sufficiently to save approximately 5% of coal bill.

Saving per year
$$\frac{150,000 \times 8,760 \times .05 \times \$4.00}{9 \times 2,000} = \$14,600.00$$

BOILER TAKE DOWN—

Will be largely eliminated.

Estimated saving per year —\$1,000.00

BOILER MAINTENANCE—

Tube replacements, etc., will be greatly reduced.

Estimated saving per year —\$500.00

COST OF PRESENT MAKE-UP WATER—

Will be eliminated.

Saving per year — $\frac{15,000 \times 8,760 \times \$1.00}{62.5 \times 1,000}$ —\$2,100.00

Total yearly savings in plant operation —\$22,324.00

Charges Against Evaporator System

FIRST COST—

Approximate total cost of Evaporator System,
including piping, lagging and erection \$26,900.00

RADIATION—

Approximate total radiation surface—800 sq. ft.

Assuming radiation = 60 B.T.U. per sq. ft. per hr.

Heat losses per hour—800 x 60—48,000 B.T.U.

EVAPORATOR BLOW—

With the system proposed, evaporator blow will
be about 2,500 lbs. per hour at 212° F. (Temp.
of raw feed 63°).

Heat losses per hour—2,500 x 149—373,500 B.T.U.

Total heat losses per hour—421,500 B.T.U.....
 Cost of these losses
 per year— $\frac{421,500 \times 8,760 \times \$4.00}{10,513 \times 2,000}$ —\$703.00
 15% per year on \$26,900.....— 4,035.00
 Yearly labor charges for evaporator system...— 1,000.00
 Total yearly charges against evaporator system—\$5,738.00

Conclusions

Total savings in plant operation, per year \$22,324.00
 Total charges against evaporator system, per year 5,738.00
 Net yearly balance.....\$16,586.00

By the use of The Griscom-Russell Evaporator System,
 continued boiler operation at high efficiency will be
 achieved, in addition to a clear profit of \$16,586.00 per year.

NOTES:—The above analysis is given for a power plant requiring 10% boiler feed make-up. For power plants requiring but 5% make-up, the relative cost of evaporating equipment is so reduced that the first cost is usually recovered within ten to fourteen months, due to power plant operating economies incident to the use of the Evaporating Plant.

As heretofore pointed out, in addition to the benefits indicated by the above analysis, large boiler overloads may be carried, because of the use of distilled feed, which means a reduction in the amount of boiler equipment otherwise necessary.

The following organizations may be mentioned as having adopted apparatus of the character described in this paper.

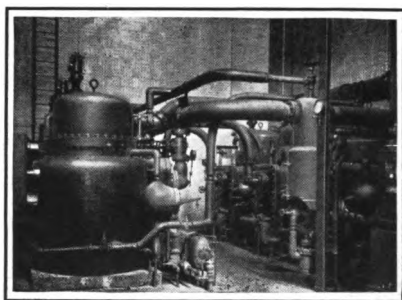
Allen & Garcia Company
Arkansas Valley Railway, Light & Power Company
Asano Portland Cement Company
Atlantic Gulf Oil Corporation
Atlantic Refining Company
Bethlehem Chile Iron Mines Company
Buffalo General Electric Company
Byllesby Engineering & Management Corporation
Carnegie Lead & Zinc Company
Central Hudson Gas & Electric Company
City of Clay Center, Kansas
City of Clinton, Oklahoma
City of Toledo, Ohio
Compania de Petroleo La Carona
Compania Transcontinental de Petroleo, S. A.
Consumers Power Company (3 Central Stations)
Delaware County Electric Company
Detroit Edison Company
Dewey Portland Cement Company
East Coast Oil Company, S. A.
Eastern Connecticut Power Company
Electric Bond & Share Company
Ford Motor Company
Fort Worth Power & Light Company
Freeport & Mexican Fuel Oil Corporation
Gallup American Coal Company
Galveston-Houston Electric Railway Company
General Electric Company
Harry M. Hope Engineering Company
Houston Lighting & Power Company
International Petroleum Company
Interocean Oil Company
Lakehurst Naval Air Station
Lehigh Portland Cement Company
Leon Steam Electric Station
Maysville Power Company
Miami Beach Electric Company
Michigan Agricultural College
Monongahela Valley Traction Company
Philadelphia Electric Company
Phoenix Utility Company
Sanderson & Porter
Snare & Triest Company
Standard Oil Company
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Stone & Webster
Tampico Electric Light, Power & Traction Company, Ltd.
Tata Oil Mills Company, Ltd.
Texas Construction Company
The Mexican Corporation, S. A.
Thompson Ice Company
Union Switch & Signal Company
United Gas & Electric Company
Universal Oil Products Company
Upjohn Company
Washington State College
West Penn Power Company
J. G. White Engineering Corporation
Wichita Falls Steam Electric Station



TAMPICO ELECTRIC LIGHT, POWER & TRACTION CO., Ltd.
TAMPICO, MEXICO

Evaporator equipment for 10,000 lbs. net per hour of
distilled boiler feed make-up. Apparatus designed and
manufactured by

THE GRISCOM-RUSSELL COMPANY



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Raw water distilling plants for prod



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